

STUDIES IN AUSTRALIAN GAMMARIDEA

(1) THE GENUS CERADOCUS

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Text-fig. 1-8.

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Acknowledgments are also due to the Council of the Canterbury University College, New Zealand, for the loan of the whole of the extensive Chilton collection of Amphipoda; to the Trustees of the Australian Museum, Sydney, for the loan of their collection, including many of Haswell's type specimens; to the University of Sydney for the loan of the Macleay collection; to the Trustees of the National Museum, Melbourne, for the loan of the Sayce collection; and to Mr. H. M. Hale, Director of the South Australian Museum, whose extensive collections from South Australian waters provide a basis for these studies.

This paper is the first of a series redescribing early Australian type Gammaridea, together with related forms collected later. Keys to the species and genera dealt with will be given where possible, but it cannot be sufficiently stressed that these do not necessarily express relationships, but are designed to permit workers to effect a preliminary sorting-out of material.

The *Ceradocus* group of genera appears to consist of the following, which may be separated by the key given below:

Metaceradocus (Chevreux 1925, p. 304); *Ceradocoides* (Nicholls 1938, p. 123); *Paraceradocus* (Stebbing 1899, p. 426); *Ceradocopsis* (Schellenberg 1926, p. 365); *Ceradocus* (A. Costa 1853, p. 170); *Quadrivisio* (Stebbing 1907, p. 160) (= *Pseudoceradocus* Shoemaker 1933, p. 11); *Bathyceradocus* (Pirlot 1934, p. 223).

CERADOCUS Group.

Gammaridae with the following characters (adapted from Stebbing 1906, p. 364).

Pleon segments 4-6 not coalesced; pleopods with two rami; uropod 3 with two elongate rami; telson cleft; antenna 1, accessory flagellum of more than 2

segments; body not at all or scarcely carinate, without groups of dorsal spinules; uropod 3 rami not very unequal.

- a. Maxilla 1, inner plate setose at apex; maxilla 2, inner plate setose along inner margin.
 - b. Antenna 1, shorter than antenna 2 *Metaceradocus*
(*M. perdentatus* Chevreux, Senegal.)
 - bb. Antenna 1, longer than antenna 2.
 - c. Peraeopods 3-5 with bases linear *Ceradocoides*
(*C. chiltoni* Nicholls, Commonwealth Bay, Macquarie Island.)
 - cc. Peraeopods 3-5 with bases expanded *Paraceradocus*
(*P. miersi* (Pfeiffer); South Georgia; ? *P. micramphopus* Stebbing, East Australia.)
- aa. Maxilla 1 and 2, inner plate setose along inner margin.
 - d. Uropod 3, outer ramus 2 segmented; lower lip without inner lobes *Ceradocopsis*
(*C. kergueleni* Schellenberg, Kerguelen.)
 - dd. Uropod 3, outer ramus normal, lower lip with inner plates.
 - e. Side plate, gnathopod 1 produced forwards to an acute angle.
 - f. Pleon segments postero-dorsally multidentate *Ceradocus*
(*Denticeradocus*).
C. (D.) rubromaculatus (Stimpson), *C. (D.) ramsayi* (Haswell), *C. (D.) serrata* (Spence Bate), *C. (D.) sellickensis*, *C. (D.) barrierensis* (Australian seas); *C. (D.) chiltoni* (New Zealand); *C. (D.) chevreuxi* (Pacific), *C. (D.) barnardi* (South Africa).
 - ff. Pleon segments not postero-dorsally multidentate. *Ceradocus* (*Ceradocus*).
C. (C.) orchestiipes A. Costa (Mediterranean, Bermudas); *C. (C.) semiserratus* (Bate) (North Atlantic); *C. (C.) torelli* (Goës) (Arctic Ocean); *C. (C.) parkeri* and *C. (C.) coleii* Kunkel (Bermudas).
C. (C.) baffini Stephenson (off Baffin Land) should probably be referred to at least a sub-genus.
 - ee. Side plate, gnathopod 1, rounded.
 - g. Mandible, palp, segment III longer than segment II. *Quadrivisia*. *Q. bengalensis* Stebbing (Pt. Canuing, Bengal; brackish water, Zanzibar). *Q. lutzii* (Shoemaker) (British Guiana, West Indies).
 - gg. Mandible, palp, segment III shorter than segment II. *Bathyceradocus*. *B. stephenseni* Pirlot (East Indies).

The group as a whole may be readily separated from the *Maera-Elasmopus* group by the setose character of the inner plates of maxillae 1 and 2. In this connection, the falcate segment III of the mandibular palp of *Metaceradocus* and the linear segment III of *Ceradocopsis* are of interest. Through the kindness of Professor G. E. Nicholls I am able to figure (Fig. 5, N-O) the mandible of *Ceradocoides chiltoni* Nicholls, which shows, in my opinion, the partial development of a process on segment I of the palp distally.

CERADOCUS A. Costa.

(For references see Stebbing 1906, p. 430, and 1910, p. 598.)

The examination of series of specimens related to *Ceradocus rubromaculatus* (Stimp.) makes it necessary to divide the genus into two sections, as follows:

- (a) *Ceradocus* (*Ceradocus*): *Ceradocus* as defined by Stebbing (1906, p. 430), with the addition of: pleon segments with postero-dorsal margin not multidenticulate. Genotype *Ceradocus* (*Ceradocus*) *orchestipes* A. Costa.
- (b) *Ceradocus* (*Denticeradocus*) sub-gen. nov.: *Ceradocus* as defined by Stebbing (1906, p. 430), with the addition of: maxilla 1, outer plate with 9 spine-teeth, palp with 13 spines; pleon segments with postero-dorsal margins multidenticulate; mandible with segment I of palp always produced on inner margin distally.

It may be noted that in Stebbing's definition cited above, he states that gnathopod 2, among other appendages, are as in *Maera*, i.e. gnathopod 2 usually much the larger in the male. This is not strictly true for the subgenus *Denticeradocus*, as here gnathopod 2 is usually of a comparative size in the two sexes, with that of the female occasionally attaining the larger relative size in aged specimens.

KEY TO THE SPECIES OF CERADOCUS (DENTICERADOCUS).

- a. Pleon segments 4 and 5 with a large medio dorsal tooth.
 - b. Telson; each half with 3 apical spines; 1 lateral hair.
 - C. (D.) capensis*.
 - bb. Telson; each half with 5 apical spines; 1 lateral hair.
 - C. (D.) ramsayi* (Haswell).
- aa. Pleon segments 4 and 5; evenly dentate.
 - c. Telson; each half with 2 apical spines, 1 lateral hair.
 - C. (D.) rubromaculatus* (Stimpson).
 - cc. Telson; each half with 4 apical spines.
 - d. One lateral hair on margin of telson.
 - e. Mandible; palp, segment III about 2/3 segment I; pleon side plates 1 and 2 well toothed above and below.
 - C. (D.) sellickensis* sp. nov.

cc. Mandible; palp, segment III sub-equal to segment I; pleon side plates 1 and 2 barely serrate.

plates 1 and 2 barely serrate.

C. (D.) serrata (Bate).

dd. Two lateral hairs on margin of telson.

C. (D.) chilton, sp. nov.

eee. Telson, each half with 5 apical spines, 1 lateral hair.

C. (D.) chevrouxi sp. nov.

The species are fairly uniform as to their maximum recorded length, which is about 25 mm.

The specimen described by Miers (1884, p. 567, pl. 52, D, d) from the Seychelle Islands under the name of *Macra diversimanus* is undoubtedly to be placed in this subgenus, and had best retain the name *Ceradocus* (*Denticeradocus*) *diversimanus* (Miers).

CERADOCUS (DENTICERADOCUS) SELICKENSIS sp. nov.

Ceradocus rubromaculatus (nec Stimpson); Hale, 1927, p. 314; 1929, pp. 213-214 excluding figs. 210 = *C. (D.) ramsayi* (Haswell), 211 = *C. (D.) serrata* (Bate); Sheard, 1936, p. 177, fig. 4.

Description. Body elongate, head nearly equal to first two segments combined, inter-antennal angle produced and rounded, separated from lateral angle by a sinus. Eyes small, sub-oval, dark.

Antenna 2 with peduncle failing to reach to the end of the peduncle of antenna 1; the whole antenna reaching just beyond this point; gland cone just fails to reach next joint, ultimate segment of peduncle 4/5 of penultimate.

Mouth parts; upper lip rounded, lower lip with small inner lobes; mandible, palp, segment I with pronounced hinge-like process on inner end, segment II long and setose on inner margin, segment III cone-shaped with long setae, about 2/3 segment I.

Maxilla 1; outer plate with 9 spine-teeth, palp with 13 spines, inner plate fringed with long hairs to base of inner margin; this plate appears to vary slightly from the shape figured to nearly the normal subquadrate.

Maxilla 2; fringed along inner margin of inner plate with two rows of setae.

Side plates; first a little the deepest with its anterior angle forwardly drawn out to a sharp point, lightly fringed with small hairs along the lower margin; second and third rounded; fourth not excavate behind; fifth, sixth, and seventh, small, bilobed.

Gnathopod 1; small, basis a little indented on the inner margin; carpus, ratio of length to width = 2:1; propodus, ratio of length to width = 1.7:1.

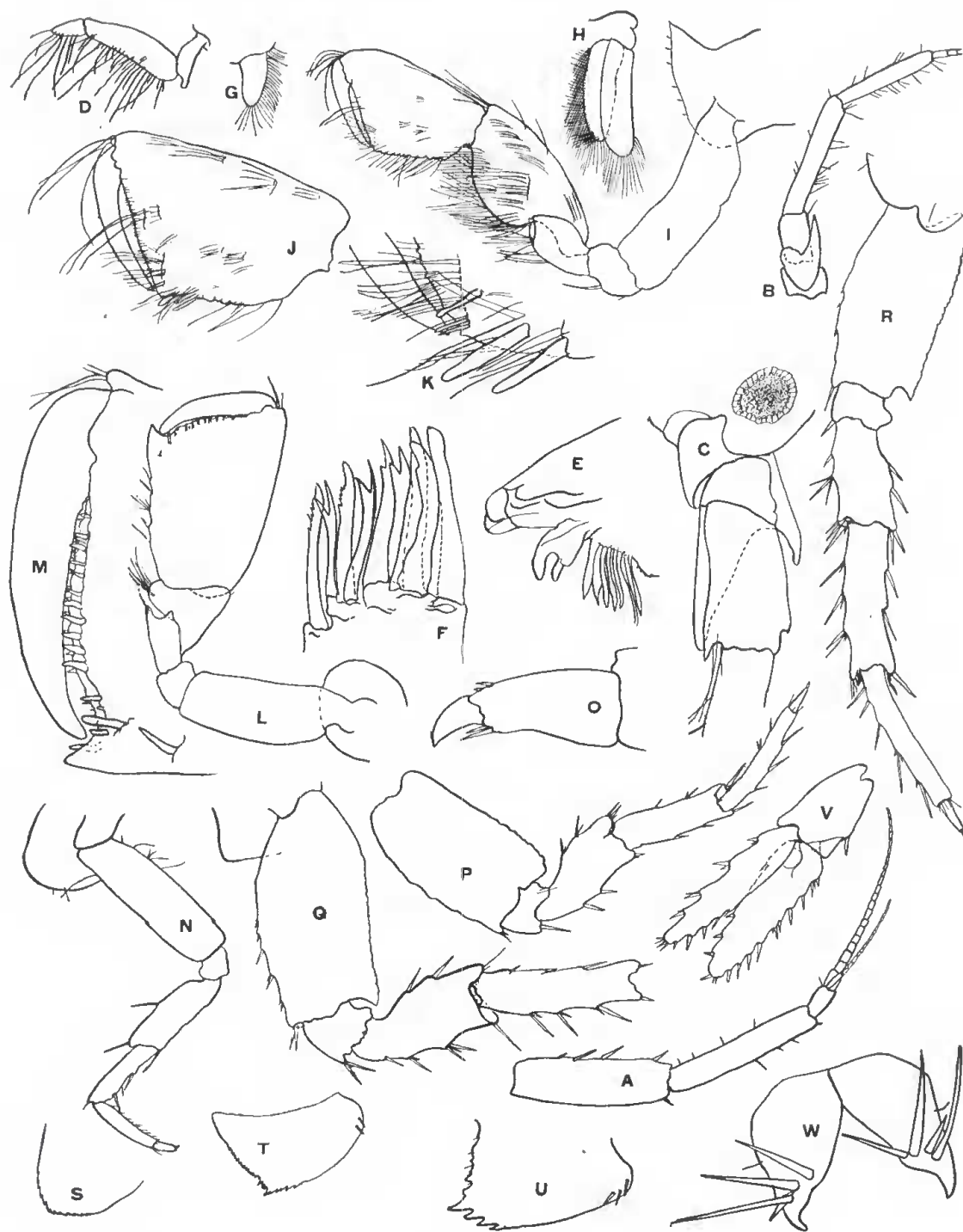


Fig. 1. *Ceradocus* (*Denticeradocus*) *sellickensis* (type ♂): A, antenna 1; B, antenna 2; C, eye lobe and basal joints antenna 2; D, mandible, palp; E, mandible, cutting edge; F, maxilla 1, spines of outer plate; G, maxilla 1, inner plate; H, maxilla 2; I, gnathopod 1; J, gnathopod 1, hand; K, gnathopod 1, defining angle palm; L, gnathopod 2; M, gnathopod 2, palm; N, peracopod 1; O, peracopod 1, dactyl; P-R, peracopods 3-5; S-U, pleon side plates 1-3; V, uropod 3; W, telson. (K.S. del.)

Gnathopod 2; enlarged in both sexes, basis stout, propodus enlarged, palm transverse, defined by a tooth-like process (which is occasionally much enlarged) not toothed, but in older specimens occasionally becoming rugose, no differentiation between the sexes.

Peraeopods 1 and 2; slender, shorter than remainder, basis the stoutest, not indented along inner margin but with several small groups of hairs.

Peraeopods 3-5; basis expanded and lightly serrate; the hinder margins produced to a simple, acute angle in peraeopods 4 and 5.

Plecon smooth on dorsal surface, pleon serrate along the postero-dorsal margins of the segments, pleon side plates 1 to 3 serrate above and below. Uropods 1 and 2 reach just beyond the peduncle of uropod 3; rami subequal, slender, the dorsal margins of these pleon segments serrate.

Uropod 3; peduncle short, rami lanceolate and elongate but irregular in outline, spinulose and truncate at the tips.

Telson; cleft, with divergent lobes, each lobe bearing 3 large and one small apical spine, with a small hair midway on each lateral margin. Branchiae; medium size, sac-like, inner wall thick.

Type (Reg. No. C. 2121, S.A. Museum).

Loc. Vivonne Bay, Kangaroo Island (H. M. Hale and N. B. Tindale); Sellick's Beach, St. Vincent Gulf (H. M. Hale, Mar., 1936), (H. M. Hale and K. Sheard, Nov., 1936, Jan., 1937), K. Sheard (Apr., 1939), Port Willunga, St. Vincent Gulf (H. M. Hale, Mar., 1937), (H. M. Hale and K. Sheard, Jan., 1939); Marino, St. Vincent Gulf (C. Baker, 1910); Weeding's Reef, Moonta Bay, Spencer Gulf (B. J. Weeding, Nov., 1938); Investigator Straits (Dr. J. C. Verco, 1910); Coffin Bay (J. T. Mortlock, 1938).

CERADOCUS (DENTICERADOCUS) RUBROMACULATUS (Stimp.).

Gammarus rubromaculatus Stimpson, 1855, p. 394.

Moera rubromaculata (Stimpson) Haswell, 1880, p. 267, pl. X, fig. 4, 1882, p. 225; 1885, p. 105, pl. XV, figs. 5-12.

Ceradocus rubromaculatus (Stimpson), Della Valle, 1893, p. 720 (part).

Ceradocus rubromaculatus (Stimpson), Stebbing, 1906, p. 430 (part); ? 1910, p. 598.

? *Ceradocus rubromaculatus* (Stimpson) Barnard, 1931, p. 124.

Stimpson's original description is as follows:

"49. *Gammarus rubromaculatus*. Rather large, spotted with crimson above, white below. Eyes sub-ovate. Superior antennae half as long as the body, inferior

ones much shorter and more slender. First pair of hands very small and weak; those of the second pair large, compressed, and with a sharp spine at the middle of the lower edge where the finger terminates. Abdomen exceeding the thorax in length or at least equalling it, the appendages excluded. Last pair of caudal stylets half as long as the abdomen; their rami long and broad, equal and spinulated along their edges. Length half an inch. Found on muddy bottom in the circum-littoral zone.

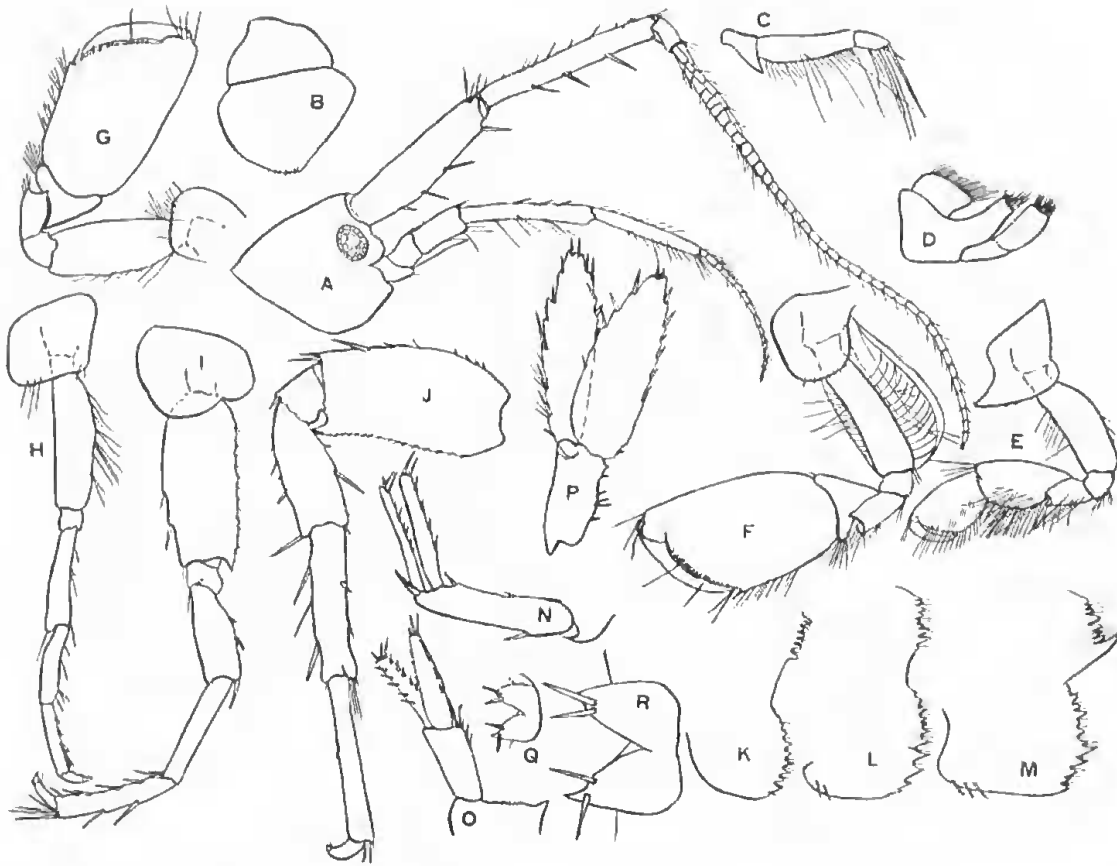


Fig. 2. *Ceradocus* (*Denticeradocus*) *rubromaculatus* (Stimpson); (Haswell's original specimen) (♀); A, head and antennae; B, upper lip; C, mandible, palp; D, maxilla 1; E, gnathopod 1; F-G, gnathopod 2; H, pereopod 1; I, pereopod 3; J, pereopod 5; K-M, pleon side plates 1-3; N-P, uropods 1-3; Q-R, telson. (K.S. del.)

“*Hab.* Australia, at Port Jackson.”

Haswell (1880, p. 267, pl. X, fig. 4), describes and figures with reasonable accuracy a specimen which he attributes to Stimpson's species from the same locality. In the same paper (p. 268, pl. X, fig. 5) he describes a new species *Moera spinosa*, from Tasmania, evidently having overlooked Bate's *Megamoera serrata* from the same locality.

Earlier in the same paper (p. 264) he ascribes provisionally to *Melita*, a new species (*M* (?) *ramsayi*) with uropod 3 missing. In a later note (p. 335) this species is placed in *Moera*. Haswell (1885, p. 105) then unites the three species and includes *Moera festiva* Chilton in the synonymy. This amalgamation is made on the form of gnathopod 2. Stebbing (1906, p. 430) follows the usage then current, but later (1910, p. 643) regards the position as still doubtful. Chilton (1916, p. 359) separates *M. festiva* Chilton from this synonymy.

The confusion was probably caused, in the first place, by the fact that Stebbing (1888, p. 1008, plates 95, 96) gave a composite description, under the name *M. rubromaculatus* Stimpson, of two species, *M. ramsayi* Haswell, and the one which is described in this paper as *Ceradocus* (*Denticeradocus*) *capensis*. Later authors, lacking material, have had no option but to ascribe specimens to this species, and the tradition has grown up that *Ceradocus rubromaculatus* (Stimp.) is a cosmopolitan species. Were the forms pelagic, this possibility would of course have to be very seriously regarded, but as they are littoral, such an easy way out cannot be taken without very serious consideration.

For my part, after studying Haswell's MS. notes, I am reasonably certain that he described a specimen which specifically conforms to Stimpson's type. Haswell's specimen is here refigured, and such parts as are necessary are re-described. In the Port Jackson material, it is easy to find specimens, male and female, immature and adult, which vary around the type specimen, and which do not cross over into the *ramsayi* form.

Actually it would appear that here we have a case of two closely-related populations existing side by side. There is some evidence to show that their breeding rates and breeding seasons are slightly different, but this is inconclusive. At all events, in life, they are readily distinguished since *C. (D.) rubromaculatus* (Stimp.) is spotted with crimson, while *C. (D.) ramsayi* (Haswell) is banded. In littoral crustacea generally, colour patterns appear to be an unreliable guide, but in this case there is a high degree of correlation between the colour and other characters.

Additions to Haswell's Description (1880, p. 267):

Mouth parts; in general like *C. (D.) sellickensis*, but mandibular palp with segments I and III subequal; maxilla 1 with inner plate more truly subquadrate, wider than deep.

Gnathopod 1 with side plate produced; basis with scattered hairs on both margins; carpus, ratio length to width = 2:1; propodus, ratio length to width = 1.6:1.

Gnathopod 2; like *C. (D.) sellickensis* but palm more oblique; as in the former species no specimens have been found with a tendency to the development of teeth on the palm.

Pereopods 1 and 2; basis indented and setose along inner margin, merus very little expanded, almost linear.

Pereopods 3–5; basis moderately expanded, hinder edge produced to longer point than in the preceding species.

Pleon side plates 1–3 well toothed above and below; 4 and 5 regularly dentate, no large teeth.

Uropods 1 and 2 reaching to end of peduncle of 3; uropod 3 with rami lanceolate and elongate but strong and wide. Telson with two apical spines and one short lateral hair on each half.

Branchiae of medium size, sac-like.

Loc. Port Jackson (Australian Museum, Reg. Nos. G. 5391, P. 2151, P. 3479, P. 3480–3481 (part), P. 3489).

CERADOCUS (DENTICERADOCUS) RAMSAYI (Haswell).

Melita ? *ramsayi* Haswell, 1880, p. 264, pl. X, fig. 1.

Moera ramsayi (Haswell), 1880, p. 334; 1882, p. 253.

Moera rubromaculatus (Stimps.) Haswell, 1885, p. 105, pl. XV, figs. 5–12 (part).

Macra rubromaculata (Stimpson) Stebbing, 1888, p. 1008 (part), pl. XCV A, pl. XCVI B.

Ceradocus rubromaculatus (Stimpson) Della Valle, 1893, p. 720 (part).

Ceradocus rubromaculatus (Stimpson) Stebbing, 1906, p. 431 (part).

Macra ramsayi Haswell, Stebbing, 1910, p. 642.

Ceradocus rubromaculatus var. *ramsayi* (Haswell), Chilton, 1923, p. 94, fig. 4.

Ceradocus rubromaculatus non. Stimpson, Hale, 1929, fig. 210.

Ceradocus rubromaculatus (Stimpson), Sheard, 1937, p. 24 (part).

To Haswell's description (1880, p. 264) is added the following:

Antenna 1; peduncle relatively stout, a little shorter than that of antenna 2. Eye sub-oval. Mouth parts; of same general type as in *C. (D.) sellickensis*, but mandible or palp with segment II longer than segment I, hinge process rounded.

Maxilla 1 with spines of palp and outer plate weak, inner plate like that of *C. (D.) rubromaculatus* (Stimpson); maxilla 2 with setae very long, plates widened. Lower lip setose.

Gnathopod 1 with side plate forwardly pointed, but not very much withdrawn; basis, with margins not indented; carpus, ratio of length to width, 2:1; propodus, ratio of length to breadth, 1.5:1.

Gnathopod 2; one side, the right in the specimen described, but generally the left, enlarged, with the propodus well expanded, and always toothed on the palm

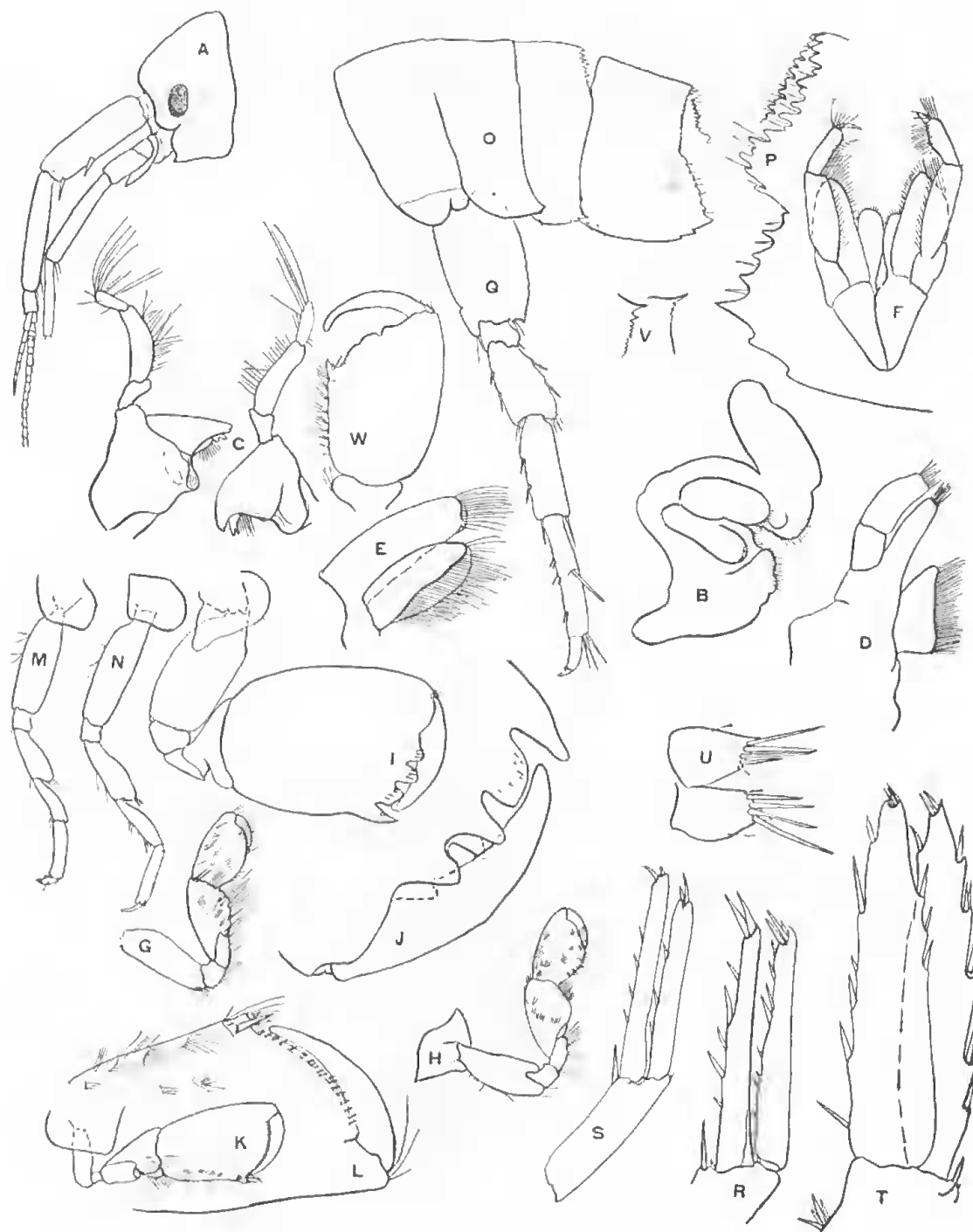


Fig. 3. *Ceradocus* (*Denticeradocus*) *ramsayi* (Haswell). (type ♂): A, head; B, lower lip; C, mandibles; D, maxilla 1; E, maxilla 2; F, maxilliped; G-H, gnathopod 1; I, gnathopod 2, right; J, gnathopod 2 right, palm; K, gnathopod 2, left; L, gnathopod 2, palm; M-N, peraeopods 1-2; O, peraeon segment 7, pleon segments 1-3; Q, peraeopod 5; R-T, uropods 1-3; U, telson; V, dorsal outline, pleon segments 4-5; W, gnathopod 2, hand, Port Stephens specimen, immature ♂. (K.S. *del.*)

in older specimens; sometimes in even immature specimens, the toothing may be solid across the palm or sometimes indented by the pressure of the finger (as figured); where teeth are present they are always three in number between the large defining tooth and the hinge.

Peraeopods 1 and 2 slender, as is usual, the basis not indented but furnished with a few setae on the inner margin; the merus is moderately expanded on its forward edge; 3–5, basis expanded, hind margin distally produced to an obtuse angle.

Pleon side plates; the first, with two very small teeth below, none above; the second with two slightly larger teeth below, slightly serrate above; and the third with two larger teeth below, more definitely serrate above. In this respect, the species is very different from *C. (D.) rubromaculatus* (Stimp.) (well serrate above and below on pleon side plates 1–3) and from *C. (D.) capensis* (side plate 2 smooth above, side plate 3 well serrate above and below). Pleon segment 4 dorsally denticulate, the mesial tooth well produced; 5 smooth, but with a prominent mesial tooth; 6 produced mesially to a small tooth.

Uropods 1 and 2 reaching just to the end of the peduncle of 3, slender. Uropod 3 with rami lanceolate and elongate, fairly strong.

Telson with four long and one short spine apically, and one short plumose hair on the mid-lateral margin of each half.

Loc. Port Jackson (W. A. Haswell); off Eden, N.S.W., 25–30 fathoms (A. Livingstone, Apr., 1922); off Norah Head, Newcastle, N.S.W., 26–38 fathoms (F. A. McNeill, June, 1921) (Chilton collection); Port Stephens; Balmoral, Port Jackson (T. Whitelegge) (Australian Museum, Reg. Nos. P. 5876, P. 3480–3481 part).

CERADOCUS (DENTICERADOCUS) SERRATA (Bate).

Megamaera serrata Bate, 1862, p. 226, pl. XXXIX, fig. 5.

Moera spinosa Haswell, 1880, p. 268, pl. X, fig. 5; 1882, p. 257; 1885, p. 105, figs. 5–12 (part).

Ceradocus rubromaculatus (Stimpson) Della Valle, 1893, p. 720 (part).

Ceradocus rubromaculatus (Stimpson) Stebbing, 1906, p. 431 (part).

Maera spinosa Haswell, Stebbing, 1910, p. 642.

Ceradocus rubromaculatus non Stimpson, Chilton, 1921, p. 71, fig. 9.

Ceradocus rubromaculatus non Stimpson, Hale, 1929, fig. 211.

It appears reasonably certain that the species described by Haswell and Bate are the same. The figures given by both authors are poor, but coupled with the descriptions, they are sufficient to justify the union. An examination of a number

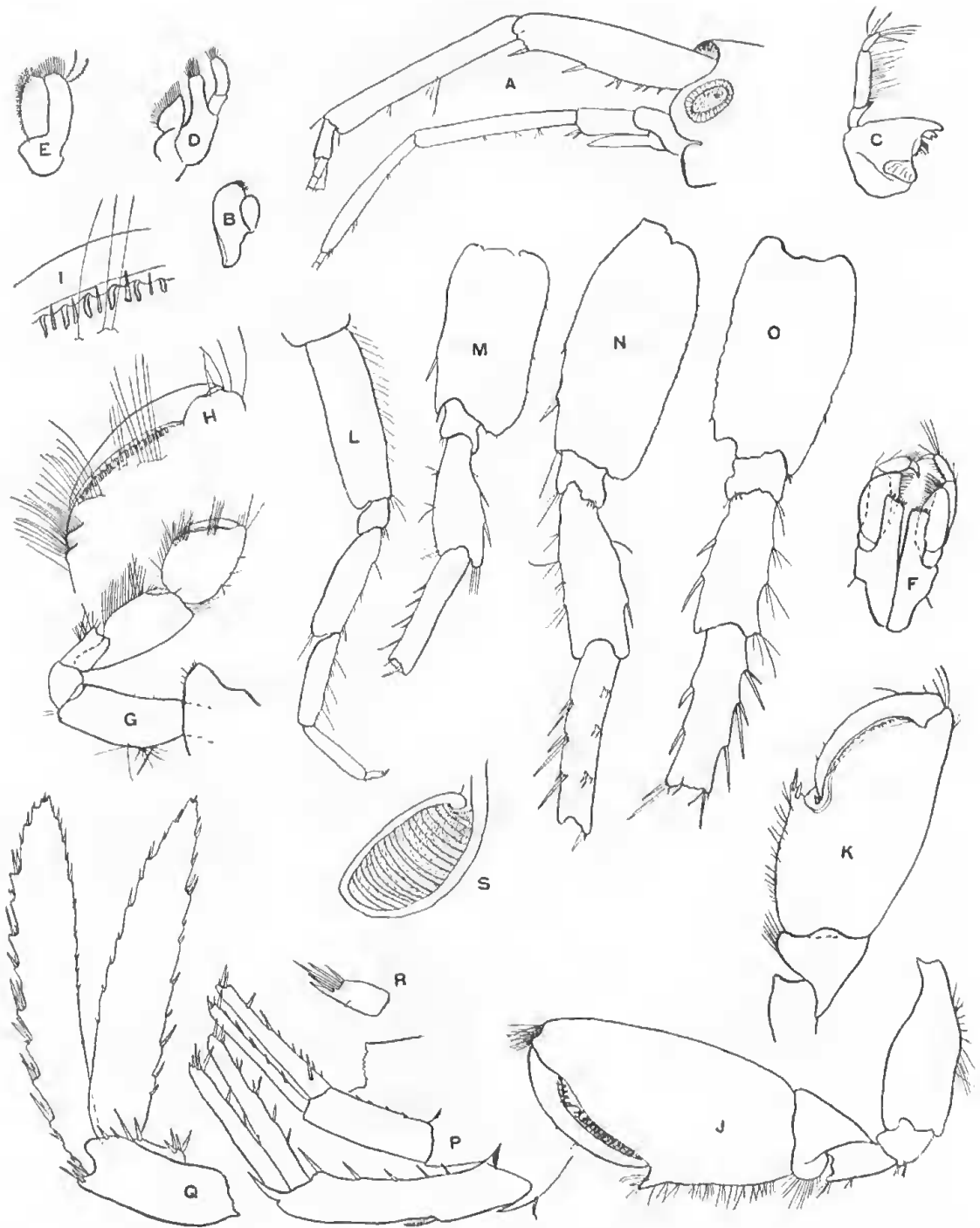


Fig. 4. *Ceradocus* (*Denticeradocus*) *serrata* (Bate); (Haswell's original specimen ♀) A, head; B, lower lip, half; C, mandible; D-E, maxillae 1-2; F, maxilliped; G, gnathopod 1; H, gnathopod 1, palm; I, gnathopod 1, detail of palm; J-K, gnathopod 2, right and left; L, peraeopod 1; M-O, peraeopods 3-5; P, uropods 1-2; Q, uropod 3; R, telson; S, branchia. (K.S. del.)

of specimens from Tasmanian localities gives no reason to suppose that there are two species occupying that area, although on the Victorian coast specimens occur which exhibit slight variations not sufficiently marked, however, to justify any separation. Additions to Bate's (1862, p. 226) and Haswell's (1880, p. 268) descriptions are:

The peduncle of antenna 2 just reaches to the end of that of antenna 1, the whole antenna reaches well beyond this point; gland cone reaching to end of next segment.

Mouth parts as usual, but mandibular palp with segment III sub-equal to segment I, hinge process pronounced.

Maxilla 2 with two plumose setae on the outer edge of the outer plate distally.

Gnathopod 1 with side plate moderately produced and pointed forwards, basis moderately expanded, setose behind, carpus longer than propodus, carpus ratio length to width = $2.3:1$; propodus ratio length to width = $1.4:1$, the palm ridged in the female as figured.

Gnathopod 2; both enlarged, with one as a rule slightly larger in both sexes, hand swollen and in very old specimens irregular in outline; palm oblique, in young specimens with a clean outline, later becoming more rugose and sometimes becoming split to form near the hinge a large flat tooth, followed by a depression, then a long, rounded rugose bulge. The finger fits into a deep pocket near the defining tooth, which is occasionally worn nearly flat.

In specimens from Westernport, Victoria, the two-toothed form, similar to that found in *C. (D.) chiltoni*, occasionally appears.

Pereopods 1 and 2 with basis very lightly indented near the body, a row of hairs along the hinder margin; 3-5 with basis expanded and sometimes produced to a small angle distally on the hinder edge; however, this is a very variable character, and I can find no correlation between this factor and others. The best that can be said is that generally there is a tendency for the basal expansion to be produced to a pointed angle in pereopods 4 and 5, particularly in the male.

Pleon side plate 1 lightly crenulate behind, a nearly obsolete tooth present above and below; 2 lightly toothed above, two very small teeth below; 3 moderately toothed above, two teeth below; 4 and 5 denticulated strongly but evenly.

Uropods 1 and 2 fairly strong, reaching just beyond the peduncle of 3; uropod 3 with rami lanceolate, strong, and elongate.

Telson with four spines, one usually small, and one lateral hair on each half. Branchiae very large, inner wall very thin.

Loc. Tasmania (Haswell's original specimens); 10 miles north of Cirenlar Head, Tasmania, Endeavour 492; Port Wynyard, Tasmania (N. B. Thudale, Apr.,

1936); Altona, Port Phillip, Victoria (M. Freame, Jan., 1933), "colour uniformly bright scarlet" (Aust. Mus. Reg. No. P. 10398); Port Phillip (O. A. Sayce); West Channel, Victoria (O. A. Sayce); Shoreham, Victoria (O. A. Sayce).

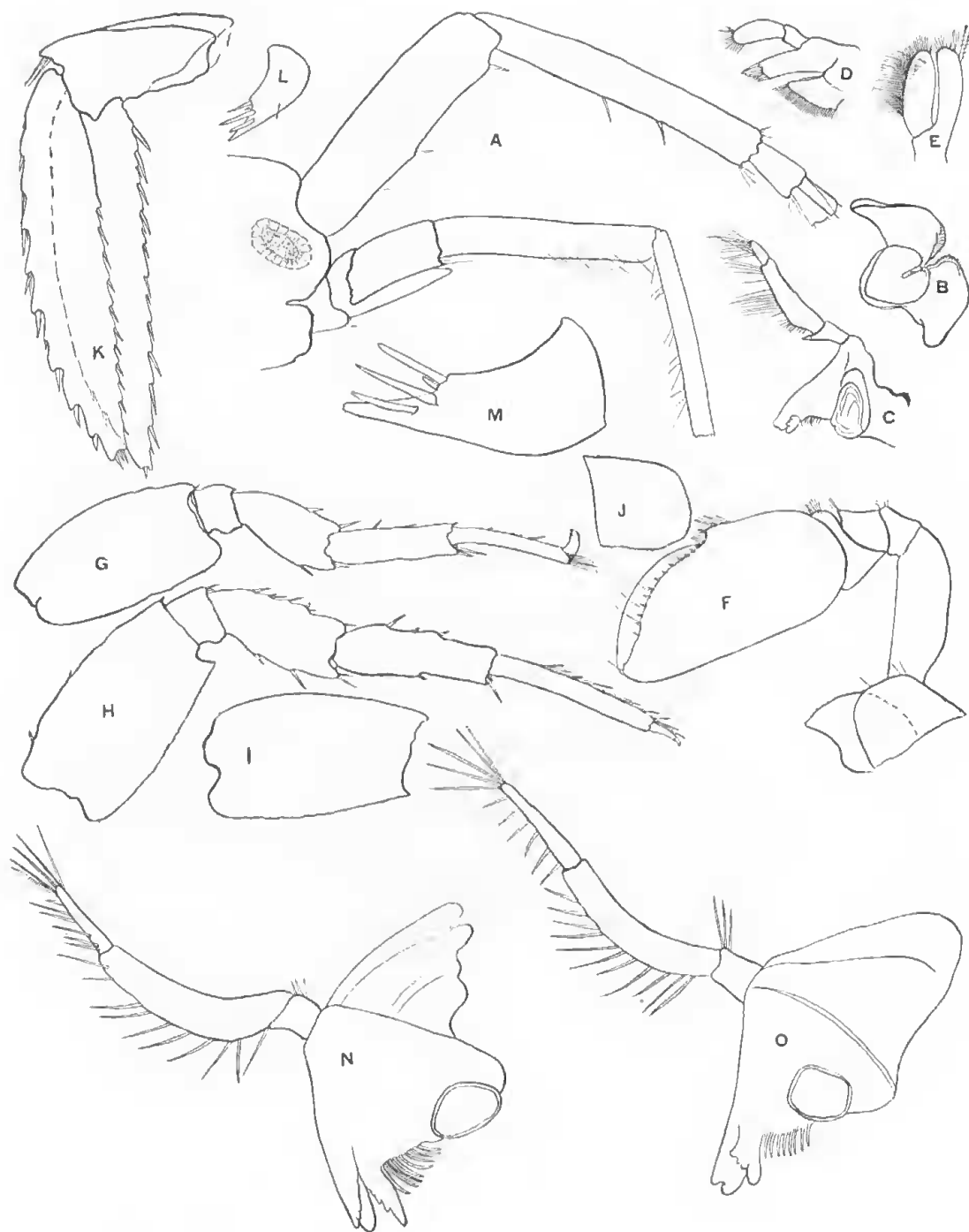


Fig. 5. A-M, *Ceradocus* (*Denticeradocus*) *serrata* (Bate); (Haswell's original specimen ♂): A, head; B, lower lip; C, mandible; D-E, maxilla 1-2; F, gnathopod 2; G-I, peraeopods 3-5; J, pleon side plate 1; K, uropod 3; L-M, telson. (K.S. del.) N-O, *Ceradocoides chiltoni* Nicholls; N-M, two views of left mandible.

CERADOCUS (DENTICERADOCUS) CHILTONI sp. nov.

Mucra spinosa Chilton non Haswell, Chilton, 1883, p. 81, t 2, f 3; 1916, p. 369.

Very like *C. (D.) serrata* (Bate), but with the following differences:

Antenna 2; peduncle fails to reach the end of the peduncle of antenna 1.
Maxilla 2 without plumose setae.



Fig. 6. *Ceradocus (Denticeradocus) chiltoni* (Chilton's original specimen ♀): A, head; B, upper lip; C-D, left and right mandibles; E, maxilla 1; F, spine-tooth from outer plate; G, maxilla 2; H, maxilliped; I, gnathopod 1; J-K, gnathopod 2, left and right; L, pereopod 1; M-O, pereopods 3-5; P-R, pleon sideplates 1-3; S-U, uropods 1-3; V-W, telson. (K.S. del.)

Gnathopod 1; carpus sub-equal to propodus, ratio length to width = 1.9:1; propodus ratio length to width = 1.9:1.

Pleon side plate 1 with margin a little uneven above, two small teeth below; 2 with margin smooth above, two small teeth below; 3 well toothed above, two teeth below; 4 and 5 evenly but lightly denticulate.

Uropods 1 and 2 not as strong as in *C. (D.) serrata* (Bate), but reach well beyond the peduncle of 3, to halfway up the rami; 3 with rami slender, lanceolate but not elongate.

Telson with 4 spines set fairly well back (see figure), and with two lateral spine-like hairs on each half. Branchiae very large, sac-like, with a thick inner wall.

In this species gnathopod 2 is subject to considerable variation (see figures) in both males and females. The tendency, however, is always towards the development of two flat-topped palm teeth, an oblique palm, and a well-developed defining tooth. Generally the left gnathopod is more strongly developed.

Locality. Auckland; Akaroa, New Zealand. Chilton collection.

A single specimen which is attributed to this species from Great Barrier Island, New Zealand, is figured.

The most noteworthy point is the fact that uropod 3 is elongate and strong, although 1 and 2 reach well beyond its peduncle.

CERADOCUS (DENTICERADOCUS) CHEVREUXI sp. nov.

Ceradocus rubromaculatus Chevreux non Stimpson, Chevreux, 1908, p. 479, fig. 6.

? *Ceradocus rubromaculatus* non Stimpson Schellenberg, 1938, p. 63.

This species is clearly marked off from the others of its section by the possession of five spines on the apex of each half of the telson. The ciliations of the inner margin of the telson lobes, the downward production of the posterior margin of the basis of pereopod 5, and the reduction of teeth, dorsal edge of the pleon segments, are of interest.

The fact that, in these specimens, the dorsal edge of the pleon segments is somewhat crenulate, suggests the retention of *Denticeradocus* as a sub-genus only.

Loc. Archipelagoes of Gambier and Tuamotu (Dr. Saurat, 1904); ? Fiji, Marshall Islands, British Solomon Islands, Philippines (Dr. Sixten Bock).

CERADOCUS (DENTICERADOCUS) CAPENSIS sp. nov.

Maera rubromaculatus Stebbing non Stimpson; Stebbing 1888, p. 1008 (part), pl. XCV (E).

Ceradocus rubromaculatus Stebbing non Stimpson, 1908, p. 81; 1910 A, p. 456.

? *Ceradocus rubromaculatus* Schellenberg non Stimpson, Schellenberg, 1925, p. 154.

This species may be separated from *C. (D.) ramsayi* (Haswell) the only other species possessing a large mesio-dorsal tooth on the margins of pleon segments 4 and 5, by the possession of only three spines on the apex of each lobe of the telson. However, from Stebbing's figures (1888, pl. XCV) other good differences are:

The eye in *C. (D.) ramsayi* (Haswell) small and sub-oval, in *C. (D.) capensis* large, egg-shaped, filling most of the interantennal angle.

Peracopods 1 and 2 with the basis strongly indented on the inner margin and strongly setose. Pleon side plate 3 with four teeth below. Uropods 1 and 2 with relatively shorter and stouter peduncles.

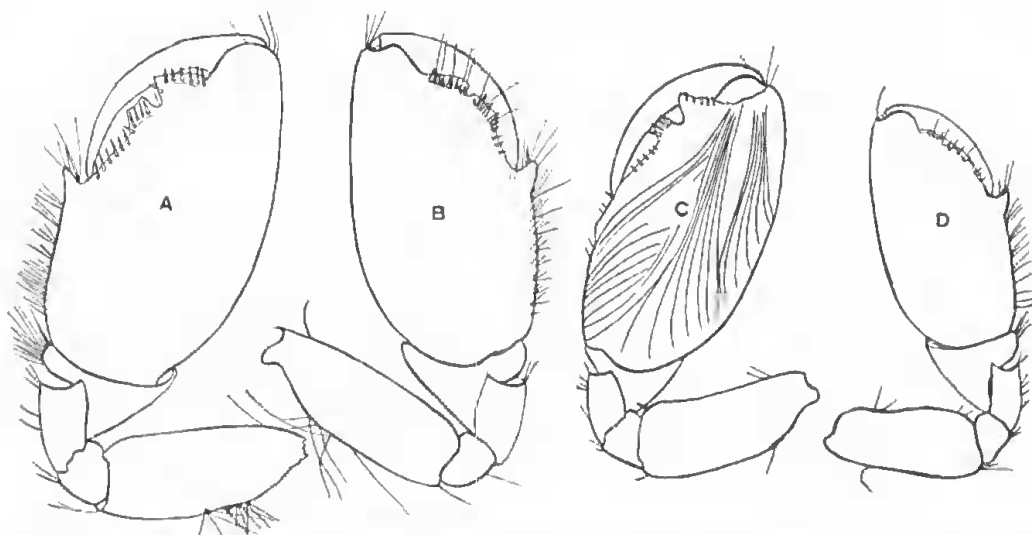


Fig. 7. *Ceradocus (Denticeradocus) chiltoni*; variation in gnathopod 2: A-B, gnathopod 2, left and right, aged ♀; C-D, gnathopod 2, left and right, aged ♂. (K.S. del.)

Re-examination of the South African specimens is needed.

Loc. Off Cape Agulhas, 274 metres, Table Bay; ? German West Africa, ? Swakopmund.

The following records cannot be evaluated from the literature. A recheck from the specimens is necessary.

Maera rubromaculatus Stimpson, Miers (1884, pp. 315–316; Port Molle; Dundas Straits; Northern Territory.

Ceradocus rubromaculatus (Stimpson) Walker (1904, p. 272, fig. 30). Gulf of Manaar. Walker's specimens certainly belong to the sub-genus.

Ceradocus rubromaculatus (Stimpson) Walker, 1909, p. 364. Wasin, in mud. Record only.

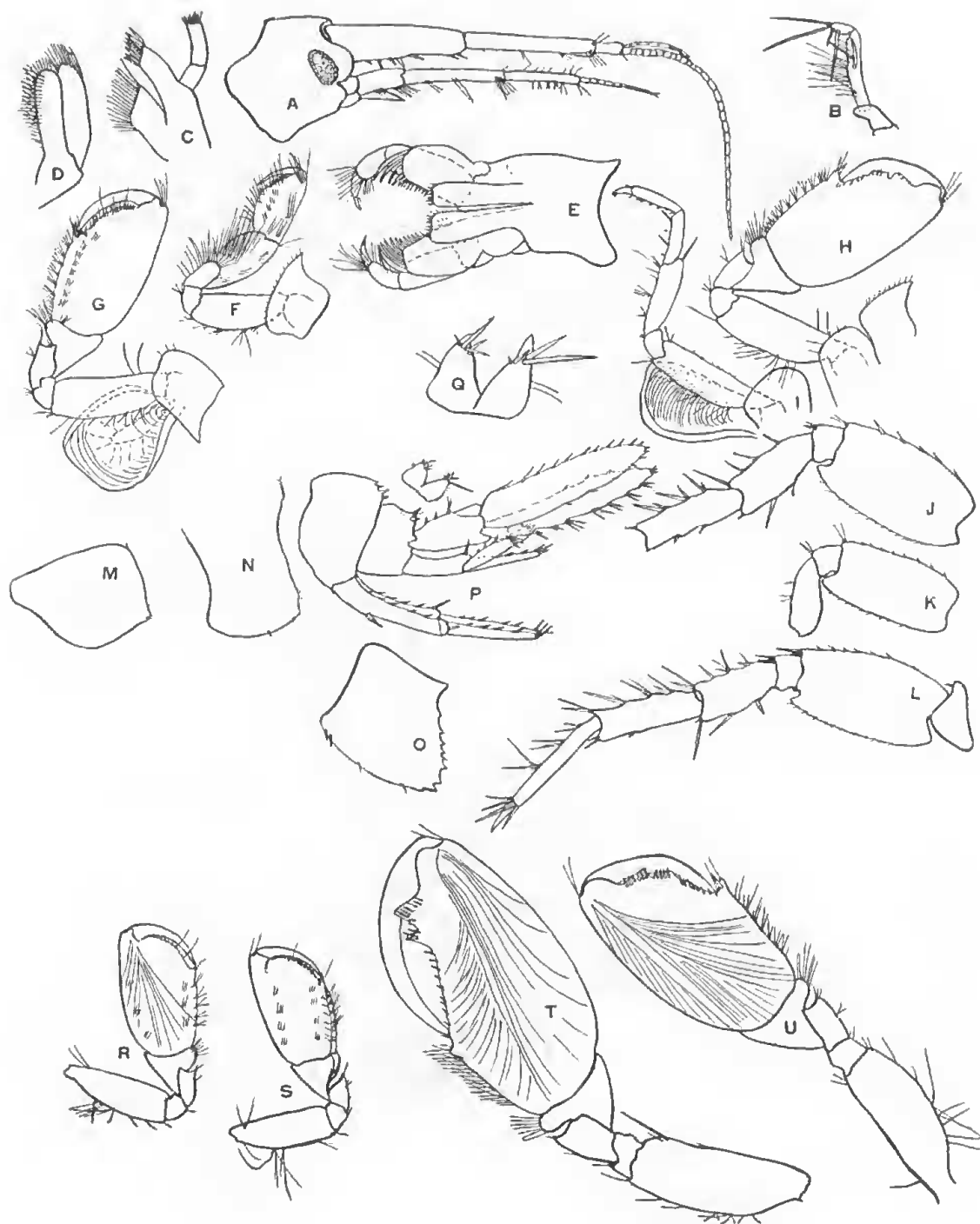


Fig. 8. A-Q, *Ceradocus (Denticeradocus) chiltoni*, Great Barrier Is., mature ♀: A, head; B, mandible, palp; C-D, maxillae 1-2; E, maxilliped; F, gnathopod 1; G-H, gnathopod 2, left and right; I, peraeopod 1; J-L, peraeopods 3-5; M-O, pleon side plates 1-3; P, urosome; Q, telson. R-U, *Ceradocus (Denticeradocus) chiltoni* from Auckland: R-S, gnathopod 2, left and right, young ♂; T-U, gnathopod 2, left and right, aged ♂. (K.S. del.)

Ceradocus rubromaculatus (Stimpson) Chilton, 1922, p. 8. 45 miles S.W. Cape Jaubert, N.W. Australia.

Ceradocus rubromaculatus (Stimpson) Tattersall, 1922, pp. 6-8, pl. I, fig. 15, 16. Abrolhos Islands, Western Australia. This is almost certainly a new species.

Ceradocus rubromaculatus Stimpson. Pirlot, 1934, p. 222. 6° 8' lat. N., 121° 19' long. E., 275 m.; 8° 43' lat. N., 127° 16' long. E., 828 m. (These depths are extreme for forms usually found in littoral waters.) Pirlot, 1936, p. 305. Lombok, Paternoster Island, etc., 0-90 m.

Ceradocus rubromaculatus (Stimpson) Barnard, 1937, p. 160, fig. 9. Red Sea. (This is probably a new species. The tendency to a very oblique palm with little definition is certainly not characteristic of the known members of the sub-genus. Probably, examination will show that other differences are correlated with this.)

Ceradocus rubromaculatus (Stimpson) Walker, 1905, p. 927. (This paper is not available to me.)

The Australian and New Zealand species may be readily separated by the character of the telson and by the presence or absence of teeth on the posterior margins of pleon side plates 1 and 2. *Ceradocus* (*Denticeradocus*) *ramsayi* (Haswell) is recognized by the prominent medio-postero dorsal tooth on each of the pleon segments 4 and 5, as noted by Haswell.

SYSTEMATIC CHARACTERS IN THE SUB-GENUS DENTICERADOCUS.

As I have not seen sufficient specimens of the *Ceradocus* group, it is not possible to generalize on the systematics of the group as a whole. However, within the sub-genus *Denticeradocus*, the following observations appear to hold good.

Growth Stages. In the immature stages both sexes are very similar, and the palm of gnathopod 2 is regular. The denticulation of the pleon appears to be fixed in pattern. Some differentiation occurs during the sexually mature stage: the palm of gnathopod 2 in the male becomes irregular and toothed, occasionally on both sides of the body, occasionally on the left, but more often on the right. The serration of the bases of peracopods 3-5 becomes more marked and the dentation of the pleon more evident. During the later stages, gnathopod 2 of the female tends to become irregular, and in some cases is more heavily toothed than in the corresponding male. Generally the more heavily toothed gnathopod is also the larger.

It would appear that the shape of the palm of gnathopod 2 is a very unreliable specific character, although its general shape and liability to the development of teeth or not may be useful as a check. In *Ceradocus* (*Denticeradocus*) *rubromaculatus* (Stimps.) and in *C. (D.) sellickensis* Sheard, no trace of the breaking-up of

the palm into teeth has been observed, although a long range of specimens has been examined. Characters which appear to be unaltered in the various growth stages, and which appear to exhibit very little variability, are: the telson, mouthparts, particularly the palp of the mandible, and the dentation of the side plates of pleon segments 1-3. Accordingly these characters have been used for the separation of the species.

Other characters which appear to be specific but which have not been checked over a wide range of specimens are: the proportion of length to width of segments V and VI of gnathopod 1, the proportionate length of the gland cone, the character of the margins of the basis of pereopods 1 and 2, and the shape of the lower hind corner of the basis of pereopods 3-5.

The eye shape and colour varies to about the same extent in all the species, the shape oval to round, colour dark red to light red (in spirit dark to pale). None of the Australian or New Zealand specimens furnish examples of the eye shape of *C. (D.) capensis* Sheard.

The close resemblances which exist between the two subgenera make me hesitate to effect any further separation on the basis of literature, particularly as it would appear that some of the Northern species are misplaced in the subgenus *Ceradocus* (*Ceradocus*). However, this is a problem which can only be solved by a worker with access to the Northern material.

Of very great interest is the tendency to the formation of flat-topped teeth on the palm of gnathopod 2, particularly in older specimens of a number of the species. It would be idle to speculate on their origin until more work has been done on the problem. An experiment carried out on *Talorchestia novae-hollandiae* Stebbing (Sheard, 1938, p. 29) tends to show that the forces operating in the production of malformations of this kind are complex.

However, it might not be out of place to suggest here that the position and incidence of the teeth may be controlled by factors affecting the growth rate of the segment and by the position of the powerful muscles within it. In all animals whose exoskeleton is periodically renewed, and which for varying periods of time is in a plastic state, mechanical stresses and strains can be expected to produce very definite effects.

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